CLAIMS

1. Method for the chromatographic separation of substances contained in a liquid sample comprising

providing a one piece separation tray having a spaced array of discrete identical upstanding chambers each exhibiting an open upper end and an open lower end and a separation medium placed in at least part of each upstanding chamber;

applying a liquid sample to said open upper end of at least one of said upstanding chambers;

then applying an eluting liquid to said open upper end of said at least one of said upstanding chambers; and

collecting at least one product fraction flowing out from the open lower end of said at least one of said upstanding chambers;

wherein a monolith of a compressible macroporous gel having in its liquid-swollen, non-compressed state a cross-sectional are which is 2-15 %, preferably 4-12 % and most preferably 5-10 %, larger than the cross-sectional area of the upstanding chamber in which it is placed is used as said separation medium and is in face-to-face contact with the wall of the respective chamber in its liquid-swollen state.

2. Method according to claim 1, wherein the monolith of a compressible macroporous gel is a cryogel that has been obtained by polymerizing a solution of one or more monomers selected from the group consisting of:

N-substituted and non-substituted (meth)acrylamides;
N-alkyl substituted N-vinylamides;
hydroxyalkyl (meth)acrylates;
vinylacetate;
alkylethers of vinyl alcohol;

styrene and ring-substituted styrene derivatives;
vinyl monomers;
(meth)acrylic acid and salts thereof;
silicic acid; and
monomers capable of forming polymers via polycondensation under freezing at a temperature below the solvent crystallization point, at which solvent in the system is partially frozen with the dissolved substances concentrated in the non-frozen fraction of solvent to the formation of a cryogel.

3. Method according to claim 1, wherein the monolith of a compressible macroporous gel is a cryogel that has been obtained by cooling an aqueous solution of polyvinyl alcohol or at least one gel forming polysaccharide selected from the group consisting of agarose, agar, carrageenans, starch and cellulose and their respective derivatives or a mixture of said polysaccharides to a temperature, at which the solvent in the system is partially frozen with the dissolved substances concentrated in the non-frozen fraction of the solvent to the formation of a cryogel, said cooling being carried out, when necessary, in the presence of at least one chaotropic agent in said aqueous solution in order to prevent gel formation before the polymer solution is frozen.

4. Method according to any of claims 2 and 3, wherein the polymer and polysaccharide, respectively, has become cross-linked.

5. Method according to any of claims 2 to 4, wherein the polymer and polysaccharide, respectively, has become modified by introducing a member selected from the group consisting a ligands, charged groups and hydrophobic groups thereinto.

6. Method according to any of claims 2 to 5, wherein the monolith has been formed by rolling or folding a sheet of a cryogel.

7. Method according to claim 1, wherein the monolith of a compressible macropouros gel has been produced by a method selected from the group consisting of
gel formation in double emulsion systems;
freeze-drying of a polymer solution;
leaching of a particulate material used as a porogen from a preformed polymer monolith;
use of gas bubbles as a porogen when gel formation proceeds in foam; and
aggregation of polymer particles or fibres (non-woven materials).

8. A separation device for use in a method for the chromatographic separation of substances contained in a liquid sample according to claim 1, which separation device comprises a one piece separation tray having a spaced array of discrete identical upstanding chambers each exhibiting an open upper end and an open lower end and a separation medium placed in at least part of each upstanding chamber wherein said separation medium comprises a monolith of a compressible macroporous gel having in its liquid-swollen, non-compressed state a cross-sectional area which is 2-15 %, preferably 4-12 % and most preferably 5-10 %, larger than the cross-sectional area of the upstanding chamber in which it is placed, which monolith is in face-to-face contact with the wall of the respective chamber in its liquid-swollen state.

9. A separation device according to claim 8, wherein the monolith is as defined in any of claims 2 to 7.

10. Process for the preparation of a separation medium for use in a method as claimed in any of claims 1 to 5, which process comprises

a) providing a mould of a rigid material having a plurality of apertures going therethrough, said apertures having a cross-sectional configuration adapted to that of the upstanding chambers of a separation tray in which the separation me-

dium prepared is to be used but having a cross-sectional area which is 2-15%, preferably 4-12% and most preferably 5-10% larger than that of said upstanding chambers;

b) sealing the apertures of the mould at the bottom thereof by means of an impervious removable plate;
c) introducing a solution of substances from which cryogels may be prepared into the apertures of the mould;
d) cooling the mould with said solution within the apertures thereof at a temperature below the solvent crystallisation point at which solvent in the system is partially frozen with the dissolved substances concentrated in the non-frozen fraction of solvent to the formation of a cryogel monolith;
e) defrosting the mould with the cryogel monoliths contained therein;
f) replacing the impervious removable plate by net with openings large enough to allow free flow of liquids therethrough but small enough to prevent the cryogel monoliths formed from passing therethrough;
g) washing the monoliths using a suitable washing medium; and
h) removing the monoliths from the mould.

11. Process according to claim 10, wherein steps e) and f) are carried out in reverse order.

12. Process according to any of claims 10 and 11, wherein said solution used in step c) is a solution of one or more monomers selected from the group consisting of:

N-substituted and non-substituted (meth)acrylamides;
N-alkyl substituted N-vinylamides;
hydroxyalkyl (meth)acrylates;
vinylacetate;
alkylethers of vinyl alcohol;
styrene and ring-substituted styrene derivatives;
vinyl monomers;
(meth)acrylic acid and salts thereof;

silicic acid; and monomers capable of forming polymers via polycondensation

13. Process according to any of claims 10 and 11, wherein said solution used in step c) is an aqueous solution of polyvinyl alcohol or of at least one gel-forming polysaccharide selected from the group consisting of agarose, agar, carrageenans, starch and cellulose and their respective derivatives or a mixture of said polysaccharides in the presence, when necessary, of at least one chaotropic agent in said aqueous solution in order to prevent gel formation before the polymer solution is frozen.

14. Process according to any of claims 10 to 13, wherein the cryogel monoliths are subjected to one or more chemical modifications before step h).

15. Process according to claim 14, wherein the cryogel monoliths are subjected to a cross-linking reaction.

16. Process according to claim 14, wherein the cryogel monoliths are modified by introducing a member selected from the group consisting of ligands, charged groups and hydrophobic groups thereinto.

17. Process for the preparation of a separation medium for use in a method as claimed in any of claims 1 to 5, which process comprises

a) providing an elongated, tubular mould having a closed end and having a cross-sectional configuration adapted to that of the upstanding chambers of a separation tray in which the separation medium prepared is to be used but having a cross-sectional area which is 2-15%, preferably 4-12% and most preferably 5-10% larger than that of said upstanding chambers;

b) introducing a solution of substances from which cryogels may be prepared into the mould;

c) cooling the mould with said solution in it at a temperature below the solvent crystallisation point at which solvent in the system is partially frozen with the dissolved substances concentrated in the non-frozen fraction of solvent to the formation of a cryogel monolith;

d) defrosting the mould with the cryogel monolith contained therein;

e) removing the closed end of the mould;

f) washing the monolith by passing a suitable washing medium through the mould;

g) removing the monolith from the mould; and

h) cutting the monolith into pieces of a size suitable for use in an upstanding chamber of a separation tray.

18. Process for the preparation of a separation medium for use in a method as claimed in any of claims 1 to 5, which process comprises

a) extruding a solution of substances from which cryogels may be prepared directly into a cold organic medium which is a non-solvent for the solutes of said solution to the formation of a continuous string of substantially uniform cross-section in which gel formation takes place; and

b) cutting the string into pieces of a size suitable for use in an upstanding chamber of a separation tray.